The Bayesian approach to inverse problems

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Abstract

Probabilistic thinking is of growing importance in many areas of mathematics. In this talk I will demonstrate the beautiful mathematical framework, coupled with practical outcomes, which results from thinking probabilistically about inverse problems.

Many inverse problems in the physical sciences require the determination of an unknown field from a finite set of indirect measurements. Examples include oceanography, oil recovery, water resource management and weather forecasting. In the Bayesian approach to these problems, the unknown and the data are modelled as a jointly varying random variable, and the solution of the inverse problem is the distribution of the unknown given the data.

This approach provides a natural way to provide estimates of the unknown field, together with a quantification of the uncertainty associated with the estimate. It is hence a useful practical modeling tool. However it also provides a very elegant mathematical framework for inverse problems: whilst the classical approach to inverse problems leads to ill-posedness, the Bayesian approach leads to a natural well-posedness and stability theory. I will overview this mathematical framework.

Speaker Biography

Andrew M. Stuart is known for his work in computational mathematics, particularly numerical methods for long-term solution of differential equations and numerical solution of stochastic partial differential equations. His current interests include data assimilation. He has won numerous awards, including the 1989 Leslie Fox Prize for Numerical Analysis, and the SIAM James Wilkinson and Germund Dahlquist Prizes in 1997. He obtained his DPhil from Oxford University in 1986, and was faculty at MIT and Stanford University. He is currently Professor and the Director of the Centre for Scientific Computing at Warwick University.

Host: Assistant Professor Hoang Viet Ha, School of Physical and Mathematical Sciences